

Field Shelterbelts

For Soil Conservation



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Field Shelterbelts For Soil Conservation

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Introduction

A shelterbelt is a barrier of trees or shrubs. The term “field shelterbelt” is used to distinguish rows of trees or shrubs on agricultural fields, from those planted around farmyards or livestock facilities (farmstead shelterbelts); from trees planted on marginal lands to change land use; and from block plantings to provide woodlots or wildlife habitat.

Wind erosion affects thousands of acres of Alberta soils each year. Eroded soils are less productive, require higher inputs for crop production and are more prone to further erosion than uneroded soils. Erosion results in damage to downwind crops, structures and buildings, requiring costly clean-up and repair. Blowing topsoil has also been cited in numerous vehicular accidents, with several resulting in personal injury.

Properly designed field shelterbelts prevent or greatly reduce the risk of wind erosion.

This publication describes three aspects of field shelterbelts:

1. wind erosion control and other benefits of field shelterbelts;
2. suitable field shelterbelt species for Alberta; and
3. management of field shelterbelts, including planning, establishment, maintenance and renovation.

Benefits

Properly placed field shelterbelts provide agronomic and other benefits. The main agronomic benefits are:

1. reduced soil erosion by wind
2. increased moisture for crop growth due to:
 - snow trapping
 - reduced moisture loss through evaporation
3. reduced wind damage to crops
4. potential for increased crop yields.

Other benefits include:

- wildlife habitat and shelter
- improved safety in winter travel due to reduced snow drifting
- lower costs of snow removal from roads
- beautification of the prairie landscape

1. Reduced soil erosion by wind

A field shelterbelt modifies the microclimate, mostly in its downwind vicinity. This microclimate includes reduced wind speed, and therefore reduced soil erosion. Reduced wind erosion is the primary reason farmers have been planting field shelterbelts on the Canadian prairies for more than 90 years.

Significant reduction of wind speed occurs downwind for a distance extending to approximately 20 times the height of the shelterbelt, and also three to five times its height on the upwind side (Figure 1). Therefore, a shelterbelt 5 m in height will provide a degree of protection for soils and crops for a total distance of up to 25 times its height, or 125 m.

Since the zone of protection provided by a single shelterbelt is limited, a series of shelterbelts is required to protect the whole field. Two to four rows are commonly planted per quarter section.

Erosion-prone soils may require as many as eight shelterbelts per quarter section. They must be planted perpendicular to the direction of the prevailing wind, to provide more complete protection.

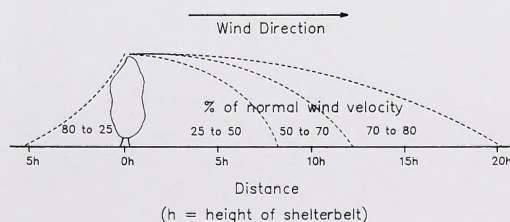


Figure 1. Approximate reduction of wind velocity by a single-row shelterbelt.



Upland game birds including ring-necked pheasants and Hungarian partridges benefit from single-row shelterbelts.

2. Increased moisture for crop growth

Field shelterbelts reduce evaporation and trap snow providing more moisture for crop growth. Snow drifts accumulate mostly on the leeward side of a shelterbelt. A dense barrier such as willow, caragana or spruce traps a narrower, deeper drift than a more porous barrier such as poplar, ash or Siberian larch. Shallow, uniform snow trapping over a greater portion of the field is preferable, but the trade-off for more even snow distribution may be reduced protection. Stubble left as tall as possible enhances snow trapping, and a crop residue cover further reduces evaporation.

Field shelterbelts use moisture and nutrients from a greater depth than most annual crops. However, additional moisture accumulated in the sheltered zone more than compensates for moisture used by



Snow trapped by shelterbelts results in higher crop yields, especially in drought-affected regions.

the shelterbelt. Maintaining adequate fertility in the whole field should also compensate for nutrients taken up by the shelterbelt system.

3. Reduced wind damage to crops

Crops benefit from the reduced wind speeds in the protected zone. The plants are less likely to be twisted by the wind or sand blasted by eroding particles.

4. Potential for increased crop yields

Most of the research conducted around the world reports yield increases due to field shelterbelts. In drought-prone prairie regions which receive snow in winter, about half the yield increase is attributed to extra moisture from snow trapping by shelterbelts. Much of the Canadian study of field shelterbelts has been conducted at Indian Head, Saskatchewan. Agriculture Canada scientists there have shown average spring wheat yield increases of five per cent, after taking into account the area taken up by the shelterbelt and adjacent sapped strip (Figure 2).

Crops vary according to their yield response to shelterbelt protection. Drought-tolerant crops such as annual cereals show the lowest response, forage crops are moderately responsive, and weather-sensitive crops (such as specialty crops and vegetables) show the highest response.

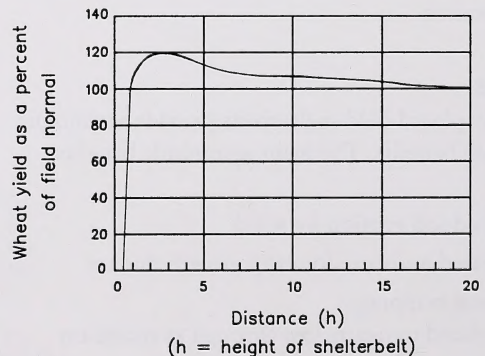


Figure 2. Shelterbelt effect on yield of spring wheat (average results of 116 site years, adapted from Kort, 1988)

Species

Many species of trees and shrubs can be used in field shelterbelts and conservation plantings. As with roses and thorns, each species has both positive and negative features which should be considered in designing field shelterbelts.

Green ash (*Fraxinus pennsylvanica*) is a hardy and drought-resistant native of Saskatchewan and Manitoba. It adapts readily to a wide range of soils, from dry, sandy locations to heavy clays. Green ash grows more quickly on moist and fertile soils, but with proper care, this tree is useful for shelterbelt planting throughout Alberta. Green ash is late in leafing out, and will drop its leaves early in fall. It reaches a mature height of 15 m, and has a long life span of up to 60 years. New plantings greatly benefit from proper weed control during the early years. Green ash is also less competitive with adjacent crops than poplar. It does not spread by suckering. In-row spacing should be 1.5 to 2 m.

Northwest poplar (*Populus x jackii* 'Northwest') is a tall, fast-growing tree that develops a wide crown. Mature trees on good soils may attain a height of 25 m with a spread of 18 m. A major disadvantage of poplars for field shelterbelts is their useful life span may be only 20 to 30 years. Poplars do well in southern Alberta where irrigation water or subsurface moisture from nearby irrigation is available. Being relatively shallow rooted, poplars are quite competitive with adjacent crops.



Green ash



Northwest poplar

Northwest poplar is resistant to leaf rust and aphids, but is susceptible to poplar bud gall mites, a serious pest in southern Alberta. This poplar does not produce cotton. Poplars in general are not the most tolerant to severe drought, although Northwest poplar is the most drought-tolerant variety. Under stressful growing conditions such as drought, poplar may die back and be invaded by cankers. Due to its low density, poplar traps very little snow and provides little protection from the wind in winter. Research data indicate that poplar provides little benefit to crop yields. In a single row, Northwest poplar should be planted 2 to 3 m apart. The tendency to spread by suckering can be aggravated by application of fertilizers near the tree and damage to shallow roots by tillage.

Acute leaf willow (*Salix acutifolia*) was introduced from Asia. Willows do well on moist, well-drained soils and tolerate flooding for up to three weeks a year. Willows perform poorly on dry areas. A fast-growing tree, acute leaf willow should reach



Acute leaf willow



White spruce

5 to 8 m in 8 or 10 years, and a height of 15 to 20 m in its 50 to 60 year life span. Spreading crown and root habits mean it will compete with adjacent crops. Acute leaf willow is best suited to central regions of Alberta west of Highway 2 or north of Highway 14. Willow should be spaced at 3 m in the row.

White spruce (*Picea glauca*) is a native of the foothills and mixed forests of Alberta. This tall-growing evergreen reaches a mature height of 30 m and a spread of 7 m. Once established, the rate of growth should be 40 cm per year. It has a long life span of 80 to 100 years.

Spruce cannot compete with faster-growing poplars or willows, so if it is used in a multiple-row shelterbelt, a minimum of 6 to 7 m should be left between the spruce and the adjacent row. Although spruce does best on moist and fertile soils, it has been planted successfully throughout agricultural areas of Alberta where native tree cover is absent. However, spruce is not very drought-tolerant, especially during the first few years. Spruce is recommended for the Black soil zone regions where moisture is not usually limiting. The recommended spacing is 3 m in the row. Controlling competitive weeds is important.

Caragana or Siberian pea tree (*Caragana arborescens*) is a legume native to Siberia. It is planted extensively throughout the Canadian prairies. It is a hardy, very drought-tolerant shrub able to survive under a variety of tough growing conditions. It will not do well on wet soils or where repeated flooding occurs.



Caragana

Mature height is 5 to 6 m. Caragana should be planted in single-row shelterbelts with a spacing of 30 to 50 cm in the row, or on the windward side of a multi-row shelterbelt, with at least 5 m between it and the adjacent row. Caragana does not sucker, but spreads by seeds. Seeds are thrown when mature pods burst open, but spreading is not usually a problem on cultivated fields. Caragana can live for 50 years or more, and can be rejuvenated.

In Saskatchewan, a commonly planted field shelterbelt is the single-row combination of caragana and green ash. Green ash are spaced at 1.5 to 2 m apart, with two or three caragana between them. The major advantages of this combination are good drought tolerance of both species, greater height than from caragana alone, and better porosity and snow trapping characteristics than from green ash alone.

Dogwood (*Cornus sericea*) is a native shrub in Alberta, found in mixed forests and along streambanks. Dogwood can tolerate a wide range of moisture conditions but performs much better in wetter areas. It is not drought-tolerant. Since the height at maturity is usually 2 to 2.5 m, dogwood may be best planted on the windward side of another species in a double-row shelterbelt. Plants should be 1 to 1.2 m apart in the row. Dogwood can spread by suckering. It is a suitable shrub plant in areas that are too wet for caragana, such as those on organic soils. Dogwood provides dense cover for wildlife and summer food for many bird species.



Dogwood

Siberian larch (*Larix sibirica*), as its name implies, is another native of Siberia. The larch is a deciduous conifer (cone-bearer which drops its leaves (needles) each year). Larch has been difficult to establish using bare root planting stock, but success rates are better now that larch is grown and distributed in containers. Siberian larch grows moderately quickly, reaching a height of 15 m when mature. The useful life of Siberian larch can be up to 70 years. Light green needles turn yellow before dropping in fall. Once established, this tree is winter hardy and drought-tolerant. Very porous in winter, a larch shelterbelt will not collect snow in deep drifts, but will promote good snow distribution. This tree is not competitive with adjacent crops, and is relatively free of disease and insect pest problems. Tree spacing should be 1.5 to 2 m in the row.

Common lilac (*Syringa vulgaris*) and villosa lilac (*Syringa villosa*) were introduced from Northern China and Mongolia, respectively. Lilacs are suitable for field shelterbelts in a wide variety of growing



Villosa lilac

conditions, except in dry, sandy soils or poorly drained soils. Reaching a height of 3 to 4 m, they can be used as single-row shelterbelts. Common lilac suckers freely, while villosa is deeper-rooted and suckers less. Lilacs are winter-hardy but need more care than caragana to establish. Spacing should be 1 m in the row and at least 5 m distance on the windward side of a larger tree if used in a double row shelterbelt.

Western chokecherry (*Prunus virginiana*) prefers rich, moist soils in its native habitat throughout the prairies, but it will tolerate dry sites. It is a suckering shrub growing up to 8 m tall, with a rounded crown. Spacing should be 2 m in the row. The fleshy pea-sized fruit is produced in long clusters which ripen in late summer. The fruit is sweet when ripe. It can be used for syrup, juice and jelly, or left for bird feed. The suckering growth habit produces thickets giving good wildlife habitat.

Silver buffaloberry (*Shepherdia argentea*) is native to the prairies. It grows on light soils around wetlands and coulees. An associated nitrogen-fixing bacteria permits good growth in nitrogen-poor soils. This large, erect, thorny shrub, or small tree, can reach a height of 4 m with a spread of 3.5 m. It suckers freely and forms a dense, irregular hedge. Spacing should be 1 m in the row. The sour fruit grows on female plants. The fruit is reddish-orange, 3 to 5 mm in diameter, and ripens in late August to September. A hard frost improves the flavour of the berry. The berries provide food for wildlife, and the shrub's suckering habit provides good cover.



Siberian larch

Sea buckthorn (*Hippophae rhamnoides*) is a suckering shrub introduced from Europe. It reaches a height of 2 to 5 m. Sea buckthorn is adapted to a wide range of soil types and grows well on light, sandy soils and slopes. It fixes its own nitrogen, so can grow well on nitrogen-deficient soils. Spacing should be 1 m in the row. Both male and female plants are needed for fruit production. The yellowish-orange, fleshy berries are very high in vitamin C and can persist on the female plants well into the next spring.

Wood's rose (*Rosa woodsii*) is a native shrub commonly occurring in bluffs, on ravines and in the sandhills throughout the prairies. It can grow on a wide range of soils. This wild rose exhibits great variation in height, spininess and spread. Spacing should be 50 cm in the row. Livestock and big game find the leaves of Wood's rose palatable from spring to fall. Birds feed on the hips during winter.

Western snowberry (*Symphoricarpus occidentalis*) is an erect, native shrub common in groupings on the open prairies, coulees and ravines. Spacing should be 50 cm in the row. The often large numbers of snow-white, waxy berries provide good food and cover for birds. The foliage is eaten by larger animals.

For information on other shelterbelt species see *Shelterbelt Varieties for Alberta* (Agdex 277/33-1), PFRA's *Planting Trees for Wildlife* and *Trees and Shrubs for Prairie Shelterbelts*.

Natural shelterbelts

Natural (or native) shelterbelts can be left when clearing land. Strips 10 to 15 m wide of existing mixed stands make excellent shelterbelts. When strips of natural shelterbelt are left, extra time will be required for measuring, marking and clearing, but the result is a fully grown, instant shelterbelt. Savings include establishment costs and time needed to grow a shelterbelt.

Field Shelterbelt Management

Planning

Field shelterbelts are an investment in both the future and long-term productivity of the soil. The benefits of shelterbelts are not achieved the first few years. At first a good deal of management is required to establish the trees. Therefore, careful planning is the first and most important process to undertake. Planning takes into account local site and field characteristics and the landholder's management systems and preferences.

Most shelterbelts in Alberta (primary belts) should be oriented north-south, because of prevailing westerly winds. Secondary belts are planted along the north and/or south edges of quarter sections or sections.

In accordance with Alberta's Public Highways Development Act, planting trees or shrubs within 30 m from the edge of any primary highway right-of-way (numbered one to 99) or any secondary highway with a 900 series number requires a development permit. These permits can be applied for and received from the local district office of Alberta Transportation and Utilities. All other roads and highways fall under municipal jurisdiction in Alberta. The local municipality should be contacted for regulations regarding set-back distances from roads and highways, as they vary considerably.

In order to take the least possible land out of crop production, shelterbelts are often planted on or near the fenceline or edge of the field. However, a set-back provides the advantages of safety through better visibility at intersections, reduced risk of snow drifting on roads and reduced costs of controlling growth of shelterbelt species in the roadside ditches. The set-back also maximizes field acreage protected from wind erosion. A strip of 30 to 45 m on the windward side of a shelterbelt is less prone to wind erosion than an open field because of its isolation. Furthermore, shelterbelts set back from fencelines are accessible from both sides. This is a decided advantage in weed control during the establishment years and other maintenance throughout the lifetime of the shelterbelt.

Other variables in planning shelterbelts are height, porosity (or density) and spacing. A tall shelterbelt will provide wind reduction and snow trapping over a greater distance than a shorter one. A porous shelterbelt will spread the trapped snow over a greater distance than a more dense one. Some trees are naturally more porous in the lower portion. If protection from wind erosion is the highest priority because soils are highly erodible, then a more dense shelterbelt such as caragana may be needed.

There are many combinations of site-specific factors that influence the designs of shelterbelts. Figure 3 shows a hypothetical design to provide both protection from wind erosion and snow management on a half section that is oriented north-south. This plan and the data in Table 1 are included to provide approximate numbers of plants. They may also be used as a guide in the planning process.

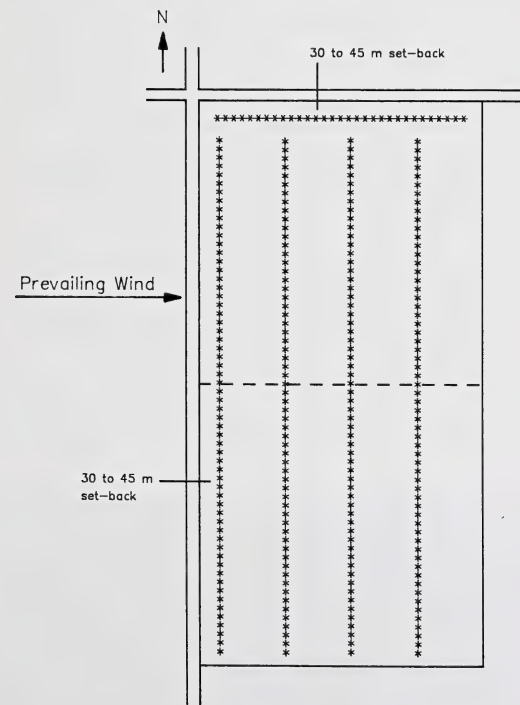


Figure 3. Example design of a single-row field shelterbelt system for a half section oriented north-south.

Table 1. Numbers of plants required for planting field shelterbelt system shown in Figure 3

Species	In-row spacing	Number of plants required ^a
white spruce	3 m	2,290
acute leaf willow	3 m	2,290
Siberian larch	2 m	3,435
green ash	2 m	3,435
dogwood	1 m	6,870
chokecherry	2 m	3,435
sea buckthorn	1 m	6,870
buffaloberry	1 m	6,870
lilac	1 m	6,870
caragana	50 cm	13,740
snowberry	50 cm	13,740
Wood's rose	50 cm	13,740
caragana/green ash ^b	60 cm	7,635 caragana; 3,820 green ash

a assumes both west and north set-backs are 30 m, and the total length of the shelterbelt in Figure 3 is 6,870 m.

b caragana and green ash are planted in the same row, in the sequence of two caragana followed by one green ash.

Assuming a cultivation strip of 2 m on each side of the shelterbelt row and 1 m occupied by the plants, then the width taken out of crop production by a young shelterbelt is 5 m. The total land lost from crop production in Figure 3 would be $5 \text{ m} \times 6870 \text{ m} = 34,350 \text{ m}^2$ or 3.4 ha (8.5 acres). This represents 2.6 per cent of the 320 acre field.

Four primary shelterbelts planted per half mile would significantly reduce wind erosion, but this design will not protect the whole field. Although wind speeds are reduced to a distance of 20 times the shelterbelt's height, protection from wind erosion is generally considered to extend to only 10 times the shelterbelt's height. Eight primary shelterbelts with a mature height of 5 m would be needed per half mile to better protect erodible fields from wind erosion.

Most field shelterbelts planted in the prairies are single rows. While single-row shelterbelts take a minimum amount of land out of production, double- or multiple-row shelterbelts also have advantages. With these types of shelterbelts there is a greater reduction of wind speed in the sheltered zone. There is also better habitat and protection for wildlife. However, wider shelterbelts occupy more land, and require proportionately more work to maintain and establish them.

In a two-row shelterbelt consisting of a shrub and a taller tree, 5 m should be left between the rows. If poplar and spruce are used, the distance between them should be 6 to 7 m. This spacing may seem excessive at planting time, but mature trees will require this space. Furthermore, poplar or willow will grow much more quickly than spruce, and their branches will damage the new growth on the spruce trees.

A number of other considerations should be taken into account during the planning process:

- Water erosion is a risk when field shelterbelts follow long or steep slopes. This risk can be greater when accumulated snow drifts melt in spring, or when cultivation leaves ridges up and down the slope.
- Locations of field approaches and widths required for machinery will help determine gap size and locations.
- The usual working widths (seeding, cultivation, spraying and harvest) will help decide set-back distances.
- Cattle will damage and eventually kill shelterbelts. Shelterbelts in fields to be grazed must be fenced. When fencing a newly planted shelterbelt, room for cultivation on both sides of the tree row must be left inside the fenced corridor.
- Stubble or grass fires will very quickly kill shelterbelts, especially young ones.

Site preparation

Moisture accumulation, especially in the drier regions of the province, and weed control are the major priorities when preparing a site. Summerfallowing the 2 to 3 m wide planting strip the year prior to planting will address both. Trees should never be planted on newly broken sod. Shelterbelt sites in fields with solonchic soils or any soils with hard layers should first be ripped to break up compacted layers.

Proper site preparation is also required to control troublesome perennial weeds. A combination of a well-timed glyphosate (Roundup) application and tillage will help control perennial grasses, sow thistle and Canada thistle. The final pre-planting application of herbicide should be trifluralin (Treflan or Rival). This application and incorporation can be done in late fall or early spring to control a wide spectrum of annual grasses and broad-leaved weeds. Trifluralin will not control the mustard family of weeds which includes stinkweed, flixweed and shepherd's purse. These troublesome weeds can be controlled after planting.

Some herbicides used in crop production can leave residues that will harm young shelterbelt plants (Table 2).

When a field shelterbelt will be planted on soils with low nutrient levels, a pre-plant fertilizer application will aid in establishment. Conduct a soil test and apply fertilizer based on the results, to bring the soil up to 75-75-150. However, fertilizing shallow-rooted trees can encourage growth of shallow roots and suckering.

Table 2. Prior use of some residual herbicides and restrictions for proposed tree planting sites ^{a,b}

Trade name	Common name	Susceptible species and comments
Tordon	picloram	<ul style="list-style-type: none"> – Caragana and villosa lilac are very susceptible – Depending on product and rate, avoid use on proposed planting sites for one to five years before planting – Leaching may occur in sandy soils low in organic matter – Picloram products should not be used near or under existing shelterbelts
Sencor, Lexone	metribuzin	<ul style="list-style-type: none"> – Phytotoxic levels do not persist from one season to the next
Atrazine, Aatrex	atrazine	<ul style="list-style-type: none"> – All shelterbelt species are susceptible – Persists longer under cold, dry conditions. Avoid use for one year before planting
Banvel	dicamba	<ul style="list-style-type: none"> – Not tested, but could be injurious to tree roots because it is relatively mobile in soil – Persists longer in dry soils – Avoid use for one year before planting

a Many other products not dangerous at prescribed rates are often used at much higher rates in spot application to control persistent weed patches. Resulting higher residues can harm young shelterbelt plants.

b For up-to-date herbicide recommendations, refer to the latest edition of *Crop Protection with Chemicals*, Agdex 606-1, Alberta Agriculture, Food and Rural Development.

Planting

Tree seedlings are highly perishable. These plants cannot be left to dry out, or the roots exposed for more than one or two minutes. Trees should be planted as soon as possible after delivery. Moist burlap can be used to help keep the plants cool and the roots protected before and during planting.

Trees should be planted about one cm deeper than they were growing in the nursery. Shallow planting will cause the roots to dry out and deeper planting may cause suffocation. Immediately following the tree planter, each tree should be heeled in to firm the soil and ensure good contact between the roots and moist soil. If the soil is dry, the seedlings should be watered in as soon as possible.



Planting a new shelterbelt

Field shelterbelts should be continuous. Aside from the unsightliness of gaps due to dead plants, wind erosion can be accelerated in areas lying behind gaps in field shelterbelts. Therefore dead or missing trees must be replaced the following spring, and again the year after, if necessary.

Weed control during establishment

One of the major reasons why field shelterbelts fail is inadequate weed control in the first three to five years. Planting sites are often exposed, on poor soils and with limited rainfall. Weeds left uncontrolled quickly compete with the young trees for the limited moisture, nutrients and light. This competition makes survival of the young trees much more difficult.

Mulches, made of either black plastic or organic material, are a good option for weed control in and beside the tree row. Mulches also conserve soil moisture and prevent wind and water erosion. In addition, plastic mulches increase soil temperature which promotes faster tree growth.

Plastic mulches are easy to use. The plastic comes in rolls. Simple-to-use, tractor-mounted and truck-mounted applicators are available for applying the plastic. The plastic is applied immediately after

planting the trees on weed-free ground. The seedlings are pulled through small slits made in the plastic at the time of application. The plastic must be resistant to ultraviolet (UV) light to prevent rapid breakdown.

Organic mulches can be made of wood chips, straw or bark. They are more difficult to apply than a plastic mulch. A layer about 10 cm thick of an organic mulch is needed to provide adequate weed control. The mulch has to be trucked to the site, which may not be economical in some areas of the province. Wood chips or bark mulches are usually preferred over straw mulches. Straw mulches should not be used in windy areas because they can be easily blown away. If using straw, take care to use clean straw to keep out grain and weed seeds.

Although mulches control weeds in and beside the tree row, weeds must be controlled along the edge of the mulch. Spraying or mowing is recommended; tillage is not recommended especially for plastic mulches.

Another weed control option is to use tillage beside the tree row and herbicides or hoeing in the tree row. A width of 1.5 to 2 m on both sides of each row should be tilled with a narrow cultivator, rototiller or tandem disc. The disc may be preferable because damage to shallow roots will be less. Weeds in the row occupied by the trees are not accessible by tillage, so they should be controlled using herbicides or hoeing. Table 3 lists herbicides for use in shelterbelts.

Equipment suitable for field shelterbelt weed control includes backpack sprayers, a handgun attached to a small field sprayer, U-boom sprayers, or small sprayers used by gardeners or landscapers. If time and manpower are available, hoeing or hand weeding can also provide safe, economical and effective weed control.

Safety precautions and labels should always be heeded. For more information on weed control in field shelterbelts, refer to *Weed Control for Alberta Shelterbelts*, Agdex 277/645-1, Alberta Agriculture, Food and Rural Development.

Maintenance

Field shelterbelts should not be routinely fertilized if they are healthy and are on fields which receive proper fertilizer management.

Spray drift from herbicide use in adjacent fields and pastures often damages shelterbelt trees. Damage ranges from minor damage to mortality. Even though some shelterbelt species are more tolerant to spray drift than others, it is important to use care when applying any herbicides near tree plantings. The herbicides which are a threat to most trees are the phenoxys (2,4-D and MCPA), dicamba, bromoxynil and picloram. One product particularly dangerous to trees is dichlorprop plus 2,4-D (Estaprop). This mixture is used as a potent brush control treatment. Note that some herbicides can be mixed or are pre-mixed formulations containing MCPA or the ester formulation of 2,4-D (e.g. Achieve Extra, Triumph Plus).

Renovation

Pruning of field shelterbelts should be restricted to the removal of diseased, dead or broken branches during the first 10 years.

An old poplar shelterbelt can be rejuvenated by cutting alternate trunks at a 45 degree angle just above the ground. If the trunks are alive, shoots will develop. The dominant shoot can then be encouraged by trimming out the others. When these shoots have grown to a useful size, the remaining old trees can be removed.

Coppicing, or topping, is not recommended for renovation. This practice results in masses of new but weak shoots which will need to be trimmed back every few years. Furthermore, the centre of a cut stump cannot heal and eventually rots.

In Saskatchewan, some 50-year-old caragana shelterbelts are being renovated by trimming with large, boom-mounted vertical trimmers. Trials are also being conducted there to determine the best age for trimming caragana shelterbelts. Pruning or trimming shelterbelts is best done during the winter when the plants are dormant.

Table 3. List of herbicides for use in shelterbelts, with recommended product rates, weeds controlled and times of application ^a

Time of application and weeds controlled	Herbicide trade name (generic name)	Product rate ^b for a 1 m x 1000 m band	Remarks
Before planting			
Most perennial and annual weeds	Roundup, Laredo, Wrangler, Renegade, Victor, 356 g/L (glyphosate)	250 - 700 mL	The rate depends upon the weeds to be controlled. Roundup should be applied during active growth of the weeds during the summerfallow year prior to planting. Do not apply if rain is expected within six hours.
Germinating annual grasses, purslane, lamb's quarters, red-root pigweed, chickweed, and wild buckwheat	Treflan EC 545 g/L Rival EC 500 g/L Bonanza 400 g/L (trifluralin)	400 - 815 mL 445 - 890 mL 545 - 1110 mL	Apply in late fall or in spring prior to planting. Incorporate herbicide by rototiller, tandem disc, discer or vibrashank cultivator. Use lower rates on sandy soils low in organic matter. Plants of the crucifer (mustard) family will not be controlled.
After planting: before weed emergence			
Germinating broad-leaved weeds	Afolan 480F or Lorox L 480 g/L (linuron)	450 - 900 mL	Apply before weed emergence or before weeds are 5 cm tall. Apply as a directed spray to base of tree/shrub seedlings. Canada thistle is not controlled. Excess moisture may leach product into the root zone, especially in sandy soils.
Germinating annual broad-leaved and grassy weeds	Princep Nine-T (simazine)	490 - 740 g	Keep mixture in spray tank in suspension with agitation. Apply only to shelterbelts established for one or more years. Product adheres to soil particles, so erosion will damage adjacent crops. Will not control perennials, but annual weed control may last for longer than one season. Use the lower rates in Brown and Dark Brown soil zones. Do not use on sandy soils.
Germinating broad-leaved and grassy weeds, quack grass, Canada thistle	Casoron 4G (dichlobenil)	11 - 17.5 kg	For shelterbelts established one year or more. Higher rate required for thistle and quack grass control. Apply in late fall or early spring, while temperatures are less than 10 - 12° C. Do not use on sandy soils.
After weed emergence: directed sprays only			
Emerged annual grasses and broad-leaved weeds and top growth of perennial weeds	Gramoxone 200 g/L (paraquat)	550 mL	Use after one year of establishment. A non-selective, non-residual herbicide. Must be directed spray only. Not translocated, so target foliage should be thoroughly covered. Do not use on small conifers unless they are protected from spray. Conifer needles sprayed accidentally will be permanently lost. Protective clothing and respirator are very important.
Many perennial weeds most annual weeds	Amitrol-T 200 g/L (amitrole)	2.2 - 3.5 L	Amitrol-T is a systemic herbicide which inhibits chlorophyll production. Use only in established shelterbelts, using care not to contact desired foliage.
After weed emergence: grassy weeds only			
Most annual grasses and seasonal control of quack grass	Fusilade II 125 g/L (fluzifop-p-butyl)	200 mL (max. rate)	Can be used as an over-all spray. Annual grasses should have two to five leaves, except green and yellow foxtail, which should have two to four fully developed leaves.

^a For up-to-date herbicide recommendations for shelterbelts, refer to the latest edition of *Weed Control for Alberta Shelterbelts*, Agdex 277/645-1, Alberta Agriculture, Food and Rural Development.

^b Herbicides listed above can be applied in 25 L of water (equivalent to 100 L/acre or 250 L/ha). If desired, Roundup, Fusilade, Treflan and Rival can be applied in 10 L of water per 1 m row, 1000 m long (equivalent to 40 L/acre or 100 L/ha). Spray pressure should be set at 210 kPa (30 psi); do not exceed 275 kPa (40 psi).

Maintenance of elm shelterbelts

Shelterbelts with American or Siberian elm require some special maintenance because of the threat of Dutch elm disease. As of 1998, Alberta is still free of Dutch elm disease.

Elm bark beetles carry the disease. They breed in dead and dying elm wood. Therefore pruning is necessary to eliminate breeding sites in elms. Preventative pruning of dead branches from healthy elm trees must be done between September 30 and April 1, when elm bark beetles are not active. Wood removed during pruning must be burned or buried immediately because stored wood can provide a breeding site for the beetles. Elm tree stumps must be removed or ground to 10 cm below the soil surface and the resulting hole filled with soil.

Monitoring for Dutch elm disease symptoms is vital to controlling the spread of the disease. The early signs of the disease appear from the latter half of June to the middle of July, when the leaves on one or more branches may wilt, droop or curl. If the tree is infected later in the summer, the leaves will droop, turn yellow and drop prematurely. Late-season infections are easily confused with normal seasonal changes in leaf colour. All these symptoms are accompanied by brown staining in the sap wood that can be seen by removing the bark of infected twigs.

Report the suspected presence of Dutch elm disease or signs of beetle activity by calling the Provincial Dutch elm disease hotline – toll-free 310-0000 and ask for 403-362-1300.

Summary

Field shelterbelts reduce soil erosion by wind, conserve soil moisture and reduce wind damage to crops. They complement good crop residue management and other conservation practices to safeguard our soils.

Field shelterbelts offer many other benefits beyond conserving soil and soil moisture. For example, they provide shade and shelter for livestock and opportunities for supplemental farm income from the sale of berries or wood. Shelterbelts also generate societal benefits such as enhancing wildlife habitat, maintaining the regional groundwater balance, protecting watersheds, cycling oxygen (by taking in carbon dioxide, a greenhouse gas, and releasing oxygen) and providing a varied and attractive landscape.

With good planning, site preparation and maintenance, field shelterbelts can play a significant role in sustainable food production systems.

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